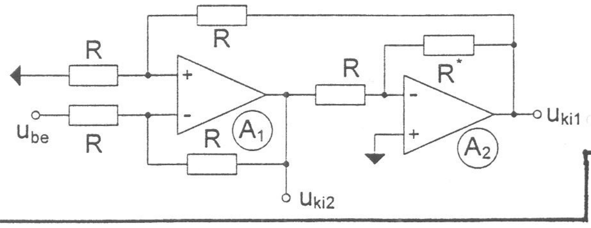
Megoldások(?): http://www.eit.bme.hu/~mihaly/3oldal.pdf

Vizsgapéldák
2008. 06. 17.

1. **Ismertesse a differenciálerősítő jellemzőit (kapcsolási rajz, a kisjelű differenciál módusú erősítés értéke, az U_{off} fogalma, a nagyjelű transzfer karakterisztika $i_{c1}= f(\Delta u)$)!**
2. **Határozza meg az alábbi kapcsolás paramétereit!**



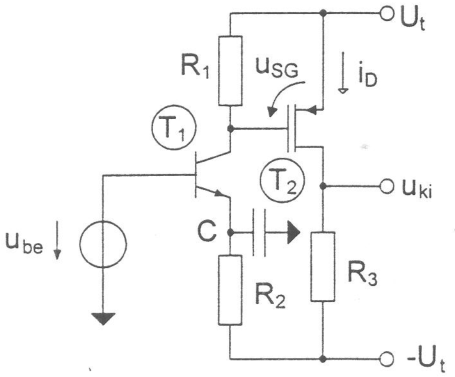
a.) $\frac{u_{ki1}}{u_{be}} = ?$, $R^* = R$, A_1 és A_2 ideális,

b.) $\frac{u_{ki2}}{u_{be}} = ?$, $R^* = R$, A_1 és A_2 ideális,

$$A_2(p) = \frac{A_0}{(1 + p/\omega_0)}, \quad A_0=10^4, \quad \omega_0 = 10 \text{ rad/s},$$

c.) $\frac{u_{ki1}}{u_{be}}(p) = ?$, $R^* \to \infty$, $A_2(p)$, A_1 ideális, d.) $\frac{u_{ki2}}{u_{be}}(p) = ?$, $R^* \to \infty$, $A_2(p)$, A_1 ideális

3. **Számítsa ki az alábbi kapcsolás munkaponti adatait és kisjelű paramétereit!**



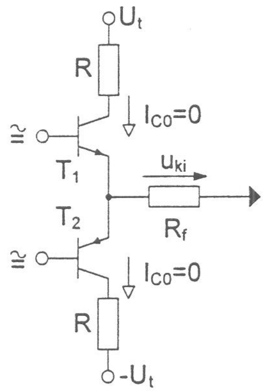
$U_t = 15$ V, T_1: n-p-n tranzisztor, $\beta=B \to \infty$, U_{BE0}=0,6 V,
T_2: p csatornás betöltéses MOS FET,

$$i_D = I_{DSS}\left(\frac{u_{SG} - U_P}{U_P}\right)^2, \quad U_P = 8 \text{ V}, \quad I_{DSS} = 4 \text{ mA},$$

a.) I_{E0}=?, I_{D0}=?, **b.)** S=?, **c.)** $\frac{u_{ki}}{u_{be}} = ?$, ha r_d=13 Ω, S=0,5mS, $C \to \infty$, **d.)** $\frac{u_{ki}}{u_{be}} = ?$, ha r_d=13 Ω, S=0,5 mS, $C = 0$,

$R_2 = 7{,}2$ kΩ, $R_1 = 6$ kΩ, $R_3 = 15$ kΩ,

4. **Határozza meg a következő „B" osztályú teljesítményfokozat paramétereit!**



$U_t = 15$ V, $U_m = 1$ V, $A = 1$, $I_{C0} = 0$, $R_f = 14\,\Omega$,

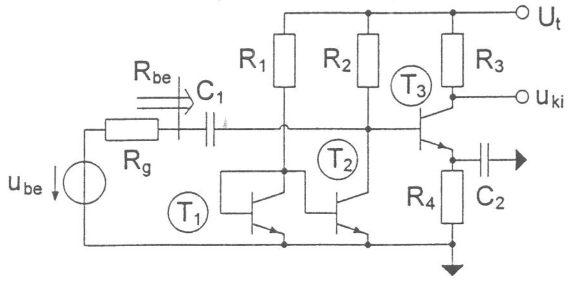
a.) $P_{f\max} = ?$, $R = 0$,

b.) $P_{d\max} = ?$, $R = 0$, (egy tranzisztorra),

c.) $P_{T\max} = ?$, $R = 0$,

d.) $P_{f\max} = ?$, $R = 1\,\Omega$

5. **Határozza meg az alábbi kapcsolás paramétereit!**



$U_t = 15$ V, $R_1 = 43{,}2$ kΩ, $R_2 = 24$ kΩ, $R_3 = 5$ kΩ, $R_4 = 6{,}16$ kΩ
$R_g = 2$ kΩ,
T_1, T_2: n-p-n tranzisztorok, β_1=B_1= β_2=$B_2 \to \infty$,
T_3: n-p-n tranzisztor, β_3=B_3=99,

a.) I_{E01}=?, I_{E02}=?, I_{E03}=?,

b.) $\frac{u_{ki}}{u_{be}} = ?$, C_1=$C_2 \to \infty$, **c.)** R_{be}=?, C_1=$C_2 \to \infty$,

d.) $\frac{u_{ki}}{u_{be}}(p) = ?$, ω_p=?, ω_z=?, C_1=10 μF, $C_2 \to \infty$

2) (A_1) felt bemeneten a feszültség megegyezik: $U^+ = U^-$

$$U^+ = \frac{U_{ki1}}{2} \; ; \; U^- = \frac{U_{be}}{2} + \frac{U_{ki2}}{2}$$

a), b): $U_{ki1} = -U_{ki2}$; $U^+ = U^- \Rightarrow -\frac{U_{ki2}}{2} = \frac{U_{be}}{2} + \frac{U_{ki2}}{2} \Rightarrow \frac{U_{be}}{2} = -U_{ki2}$

a) $$\frac{U_{ki1}}{U_{be}} = \frac{-U_{ki2}}{U_{be}} = \frac{1}{2}$$

b) $$\frac{U_{ki2}}{U_{be}} = -\frac{1}{2}$$

c), d): $U_{ki1} = -A_2 U_{ki2} \Rightarrow U_{ki2} = -\frac{U_{ki1}}{A_2}$

c) $$U^+ = U^- \Rightarrow \frac{U_{ki1}}{2} = \frac{U_{be}}{2} + \frac{U_{ki2}}{2} \Rightarrow U_{ki1} = U_{be} + \left(-\frac{U_{ki1}}{A_2}\right)$$

$$U_{ki1}\left(1 + \frac{1}{A_2}\right) = U_{be} \Rightarrow \frac{U_{ki1}}{U_{be}} = \frac{1}{1+\frac{1}{A_2}} = \frac{A_2}{A_2+1} = \frac{\frac{A_0}{1+p/\omega_0}}{\frac{A_0}{1+\frac{p}{\omega_0}}+1} =$$

$$= \frac{A_0}{A_0+1+\frac{p}{\omega_0}} = \underbrace{\frac{A_0}{1+A_0}}_{\simeq 1} \frac{1}{1+\frac{p}{\omega_p}} \; ; \; \omega_p = (1+A_0)\omega_0 \simeq 10^5 \text{ 1/s}$$

d) $$\frac{U_{ki2}}{U_{be}} = -\frac{\frac{U_{ki1}}{A_2}}{U_{be}} = -\frac{1}{A_2}\frac{U_{ki1}}{U_{be}} = -\frac{1}{\frac{A_0}{1+\frac{p}{\omega_0}}} \cdot \frac{A_0}{1+A_0} \frac{1}{1+\frac{p}{\omega_p}} =$$

$$= -\underbrace{\frac{1}{1+A_0}}_{\simeq 10^{-4}} \frac{1+\frac{p}{\omega_0}}{1+\frac{p}{\omega_p}}$$; ω_p mint fent

3) a) $I_{E_0} = \frac{U_t - U_{BE_0}}{R_2} = \frac{15 - 0,6}{7,2} = \underline{\underline{2mA}}$

$U_{SG_0} = I_{E_0} R_1 = 2 \cdot 6 = 12V$; $I_{D_0} = 4 \left(\frac{12-8}{8} \right)^2 = \underline{\underline{1mA}}$

b) $S = \left. \frac{\partial i_D}{\partial u_{SG}} \right|_{I_{D0}} = I_{DSS} \, 2 \, \frac{U_{SG} - U_P}{U_P^2} = 4 \cdot 2 \, \frac{12-8}{8 \cdot 8} = \frac{8 \cdot 4}{8 \cdot 8} = \underline{\underline{0,5mS}}$

c) $\frac{u_{ki}}{u_{be}} = \frac{R_1}{r_a} \cdot S \, R_3 = \frac{6}{26} \cdot \frac{1}{2} \cdot 15 \cdot 10^3 = \frac{45}{26} \cdot 10^3 \simeq \underline{\underline{1731}}$

d) $\frac{u_{ki}}{u_{be}} = \frac{R_1}{r_a + R_2} \cdot S \cdot R_3 = \frac{6}{7,213} \cdot \frac{1}{2} \cdot 15 \simeq \underline{\underline{6,24}}$

4) a), b), c) $P_f = \frac{1}{2} I_f^2 R_f$; $P_t = \frac{2}{\pi} I_f U_t$; $P_D = P_t - P_f = \frac{2}{\pi} I_f U_t - \frac{1}{2} I_f^2 R_f$

a), b) $I_{f\,max} = \frac{U_t - U_m}{R_f}$; a) $P_{f\,max} = \frac{1}{2} I_{f\,max}^2 R_f = \frac{1}{2} \frac{(U_t - U_m)^2}{R_f} = \underline{\underline{7W}}$

b) $P_{t\,max} = \frac{2}{\pi} I_{f\,max} U_t = \frac{2}{\pi} \underbrace{\frac{U_t - U_m}{R_f}}_{1A} \cdot U_t = \underline{\underline{9,55W}}$

c) $\frac{\partial P_D}{\partial I_f} = \frac{2}{\pi} U_t - I_f R_f = \emptyset \Rightarrow I_f = \frac{2}{\pi} \frac{U_t}{R_f}$; $P_{D\,max} = \frac{2}{\pi} \frac{2}{\pi} \frac{U_t^2}{R_f} - \frac{1}{2} \left(\frac{2}{\pi} U_t \right) \cdot \frac{1}{R_f} =$

$= \frac{2}{\pi^2} \frac{U_t^2}{R_f} \simeq 3,26W \rightarrow P_{D\,1\,tr} = \frac{3,26}{2} W = \underline{\underline{1,63W}}$

d) $I_{f\,max} = \frac{U_t - U_m}{R + R_f} \Rightarrow P_{f\,max} = \left(\frac{U_t - U_m}{R + R_f} \right)^2 \frac{R_f}{2} \simeq \underline{\underline{6,1W}}$

5) a) $I_{E01} \equiv I_{E02} = \dfrac{U_t - U_{BE_0}}{R_1} = \dfrac{14,4}{43,2} = \dfrac{1}{3}\ mA$

$$I_{E03} = \frac{U_t - I_{E02} R_2 - U_{BE_0}}{R_4 + \dfrac{R_2}{\beta+1}} = \frac{15 - 8 - 0,6}{6,16 + 0,24} = 1\ mA \quad ; r_{d_3} = 26\ \Omega$$

b) $$\frac{u_{ki}}{u_{be}} = -\frac{R_2}{R_g + R_2} \frac{\alpha R_3}{r_a + \dfrac{R_g \times R_2}{\beta+1}} \simeq -\frac{24}{26} \frac{0,99 \cdot 5}{150} \cdot 10^3 \simeq -30,7$$

c) $$R_{be} = R_2 \times \{(\beta+1) r_a\} = 24k \times 2,6k \simeq 2,35\ k\Omega$$

d) $$\frac{u_{BE}}{u_{be}} = \frac{R_{be}}{R_g + R_{be} + \dfrac{1}{pC_1}} = \frac{pC_1 R_{be}}{1 + pC_1\{R_g + R_{be}\}}$$

$$\omega_z = \frac{1}{C_1 R_{be}} = \frac{1}{10^{-5} \cdot 2,35 \cdot 10^3} = \frac{100}{2,35} \simeq 42,5\ r/s$$

$$\omega_p = \frac{1}{C_1\{R_g + R_{be}\}} = \frac{1}{10^{-5} \cdot 4,35 \cdot 10^3} = \frac{100}{4,35} \simeq 23\ r/s$$